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CODE OF SAFETY FOR ACETIC ACID

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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CODE OF SAFETY FOR ACETIC ACID

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Indian Standard
CODE OF SAFETY FOR ACETIC ACID

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 24 June 1969, after the draft finalized by the Chemical Hazards Sectional Committee had been approved by the Chemical Division Council.

0.2 Acetic acid, also termed ethanoic acid in chemical literature, is represented by the formula CH_3COOH. It is an important organic acid used in many industrial processes, such as manufacture of rubber, plastics, pharmaceuticals, dyes, insecticides, photographic chemicals and textiles. It is the primary raw material for the manufacture of acetic anhydride and acetates including acetate fibres.

0.3 If all hazards, protective measures and safeguards are made known to the personnel handling acetic acid, it is possible to reduce the potential injuries and damage resulting from injuries to a minimum. It is recommended that all the data given in this code should be used to the fullest extent.

1. SCOPE

1.1 This code describes the properties of acetic acid, the nature of hazards associated with it and the essential information on storage, handling, packing, labelling, disposal of waste, cleaning and repair of containers, selection and training of personnel, personal protective equipment and first aid.

1.1.1 This code does not deal with the specifications for design of buildings, chemical engineering plants, storage vessels and equipment for operations control and waste disposal.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 4155-1966* shall apply.

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*Glossary of terms relating to chemical and radiation hazards and hazardous chemicals.

3. PHYSICAL AND CHEMICAL PROPERTIES

3.1 Some of the important physical and chemical properties of acetic acid are:

a) Physical state	Liquid, above 16·6°C. Solidifies at lower temperatures
b) Colour	Colourless
c) Odour	Characteristic vinegar odour, pungent
d) Boiling point (760 mm of mercury)	118·1°C
e) Relative density (20°C/4°C)	1·049
f) Freezing point	16·6°C
g) Flash point:	
Open cup	43°C
Closed cup	40°C
h) Explosive range, lower limit	4 percent by volume in air
j) Ignition temperature	565°C
k) Vapour density (air = 1)	2·07
m) Corrosivity	Highly corrosive to metals at dilute concentrations, but somewhat less so when glacial
n) Reactivity	Reacts readily with most common metals (except aluminium), basic salts and amines. Reacts vigorously with oxidizing materials

4. HAZARDS ASSOCIATED WITH ACETIC ACID

4.1 Health Hazards — Hazards result from both contact with skin or eyes and inhalation of vapours. The threshold limit of acetic acid accepted at present is 10 parts per million in air or 25 mg per cubic metre of air.

4.1.1 *Local Effects* — Acetic acid is dangerous when improperly handled. Concentrated solution of acetic acid (30 percent or more) may be destructive to any body tissues which come in its contact. Contact with the eyes very rapidly causes severe damage which may result in total loss of sight. Repeated contact with diluted solutions may cause dermatitis, severe injury or death.

4.1.2 *Systemic Effects* — Inhalation of concentrated vapour or a mist from hot acid may cause damage to the upper respiratory tract and even to the lung tissues. Repeated inhalation of the mist may cause a chronic inflammation of the upper respiratory tract and chronic bronchitis.

4.2 Fire and Explosion Hazards — These types of hazards are not normally associated with acetic acid. However, leakage from containers may come in contact with metals and generate hydrogen. This, in confined spaces may cause explosion or fire. Although not classed as a flammable liquid, acetic acid, if ignited, will burn in air.

5. STORAGE

5.1 Corrosion of Containers — Acetic acid is very corrosive, particularly when dilute. It attacks most common metals and is best stored in aluminium, duriron, hastelloy, stoneware, stainless steel or glass-lined containers. All types of stainless steel are not sufficiently resistant and it is recommended that types 316 or 318 be used. Organic linings, such as synthetic resins or rubber are not satisfactory for prolonged contact and should be carefully selected after testing their suitability for the duration of contact. Dilute acid will corrode aluminium.

5.2 Tanks — Storage tanks may be constructed of aluminium or stainless steel. Aluminium, in contact with acetic acid, is slowly attacked with the consequent formation of a layer of aluminium oxide over the surface. This prevents further corrosion, but the oxide may also be suspended in the acid giving it a cloudy appearance. Continued formation of aluminium oxide shall result in the formation of a layer of sludge at the bottom of the tank which should be cleaned out at regular intervals. Vents for the tanks should be properly sized and, if necessary, steam-traced to prevent plugging with solid acetic acid.

5.2.1 Where low ambient temperatures might be expected, tanks for storing glacial acetic acid should be provided with heating arrangement to prevent the contents from freezing. Care should be taken not to heat the acid to boil.

5.2.2 Outdoor storage tanks should preferably be diked as a precaution against tank failure.

5.2.3 Gauge glasses should be guarded.

5.2.4 Tanks should be located at a safe distance away from possible sources of ignition.

5.3 Drums and Carboys — Where drums and carboys are stored, natural ventilation is normally adequate. If vapours are present in sufficient concentrations to cause irritation, forced ventilation is required.

Glass carboys used for storage of acetic acid should be of sound construction and kept in strong individual wooden or metal crates. Care shall be taken to see that the ambient temperature does not fall to or below the freezing point of acetic acid.

5.3.1 Filled boxed carboys of acetic acid should not be tiered more than three carboys high. Empty boxed carboys should be stored on their flat side, not over four tiers high, in such a manner that the necks will not protrude into aisles or passageways.

6. HANDLING

6.1 Since the vapours of acetic acid are irritating to the eyes, they should be adequately protected whenever it is present in any considerable amount.

6.2 The carboys shall not be carried on shoulders. Suitable devices, like tipple and siphon pump, should be used for removing contents. Care should be taken in cold weather to avoid sudden movement of glass carboys containing lumps of solidified acid.

6.2.1 Be sure that the closures are securely fastened before moving either filled or empty carboys.

6.2.2 Place a cap or boot over the neck of the carboy before moving it.

6.2.3 Use specially designed hand-trucks for transporting individually boxed carboys about the plant. Do not use hooks.

6.2.4 Never handle carboys by the closure or the neck.

6.2.5 Never ‘walk’ a carboy on the edge of the box.

6.2.6 When removing full or empty boxed carboys from storage tiers, trucks or cars and when stacking full or empty carboys, the neck of the bottle shall never be tilted towards the workman.

6.3 Spills and Leakage — An unusually strong odour of acetic acid is a good indication of spillage or leakage. Material may be flushed with water or neutralized by readily available basic compounds, such as soda-ash. Neutralization is preferable since this minimizes the corrosion of sewer lines.

6.4 Fire and Explosion — In case of fire, water, carbon dioxide and dry chemical extinguishers are recommended.

7. UNLOADING AND EMPTYING

7.1 Tank Cars

7.1.1 Tank cars should be spotted accurately on level track at unloading station. Brakes should be set and wheels blocked.

7.1.2 In cold weather, the contents may freeze and in that case the contents shall be thawed by steam heat. Vents of tank cars shall be opened to avoid pressure built-up before heat is applied. The bottom end of the tank, opposite the steam inlet, will be the last part to thaw. When this section of the tank is warm to the touch, heating may be discontinued. The time required for heating will vary depending upon temperature and weather conditions. Care shall be taken that the acid is not heated to a boil.

7.1.3 Tank cars may be emptied through a dome eduction pipe or through the bottom outlet, using air pressure or pump. If air is used, the pressure shall not exceed the maximum stencilled on the car since excess pressure may seriously damage aluminium cars. If the safety disk is ruptured, it shall be replaced by a disk furnished by the supplier. Do not use a substitute disk under any circumstances.

7.1.4 Before unloading through bottom outlet, heat valve leg thoroughly with live steam to melt any solid acetic acid present. Before removing bottom outlet cap, open and close valve to make sure that it is working freely.

7.1.5 Make sure that vents are working properly when emptying through a pump. It is possible that the tank may collapse due to decrease in the internal pressure as the contents are removed. To ensure against such collapse, the dome cover should be left slightly open.

7.1.6 After making sure that the valve is closed, cautiously remove cap from outlet and connect to unloading line. Empty tank car completely before disconnecting.

7.1.7 Replace all covers, caps, etc, and blow out heater coil with compressed air until free from condensate. Do not replace plugs in inlet and outlet connections of heater coil during cold weather. The ends shall be left open to permit any residual moisture to drain out freely and prevent freezing in the coil.

7.1.8 In the event of any difficulty in unloading, contact supplier at once for instructions. Report any damage or defects in car when returning it. Do not attempt to wash out.

7.2 Drums

7.2.1 Drums are preferably emptied through a stainless steel valve and nipple assembly which fits the bung on the end of the drum.

7.2.2 Never apply air pressure to aluminium drums in order to transfer contents. The drum may be seriously damaged, if not ruptured.

7.3 Carboys

7.3.1 When opening carboys, always keep the hands and face to the side of the carboy neck — never over it. In the case of big carboys, the recommended method of removing the wire holding the stopper in place is to use a wire cutter, preferably the face type. Never attempt to remove the wire by twisting or prying. To do so will frequently break the neck of the bottle and injure the workman.

7.3.2 Never use air pressure to empty carboys. Use a tilter especially designed for the purpose, or a safety siphon fabricated of material resistant to acetic acid. Make sure that the solid acetic acid, if any, is completely thawed. The shifting of masses of solid acid may result in breakage of carboys.

8. PACKING AND LABELLING

8.1 Packing — Acetic acid shall be packed in the following containers.

8.1.1 *Glass Carboys* — These should be of sound construction and kept in strong wooden or metal crates.

8.1.2 *Polyethylene Carboys* — These should be heavy duty ones and, preferably, kept in strong wooden or metal crates.

8.1.3 *Metal Drums* — These should be of stainless steel or aluminium.

8.2 Labelling — Each container, including tank cars, shall carry an identifying label or stencil containing the following information.

8.2.1 Name and address of the manufacturer.

8.2.2 Quantity in kilograms or litres.

8.2.3 Each container of acetic acid shall also bear a label depicting the symbol given in Fig. 7 of IS:1260-1958*. The lower half of the label shall have the following information printed in red letters. Any other label, warning or statement required by statutes, regulations or ordinance may also be used in combination or separately.

ACETIC ACID

DANGER ! Causes severe burns.

Do not get liquid or vapour into eyes or on skin or clothing.

Keep away from heat and open flame.

In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. Get medical attention.

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*Code of symbols for labelling of dangerous goods.

9. GENERAL PREVENTIVE MEASURES

9.0 General — Safety in handling acetic acid depends mainly upon the effectiveness of the adequate instructions on approved and safe methods of handling to the workers so engaged.

9.1 Employee Selection and Training — Prior to assignment to processes involving the handling of acetic acid, all individuals should have a replacement physical examination and, in order to properly protect their health, those who have the following conditions should be excluded from assignment to such processes:

a) Chronic skin conditions,
b) Chronic diseases of the upper respiratory tract and the lungs,
c) Only one eye, and
d) Uncorrected highly faulty vision.

9.1.1 Employees should be instructed primarily in regard to the corrosive properties of acetic acid and safe handling procedures.

9.1.2 Employees should be thoroughly familiar with the location and operation of safety showers, eye-washing fountains and other protective service installations.

9.1.3 Employees should be instructed to check vents frequently which may become plugged due to the solidification of acetic acid at low ambient temperatures. This may lead to the rupture or collapse of tanks or pipelines, particularly if fabricated from aluminium, due to pressure differentials built up in loading or unloading. It is desirable to design out this danger as far as possible.

9.1.4 Instructions should be given regarding when, how and where to use the personal protective equipment. They should be aware of the places where they are kept.

9.1.5 All employees who are constantly engaged in processes involving the handling of acetic acid should have a careful physical examination at least once each year.

9.2 Personal Protective Equipment

9.2.1 Emergencies should be anticipated, and proper personal protective equipment in sufficient quantities should be located at convenient places throughout the premises to be readily available in case of need. It should be examined and tested regularly and maintained in ready-to-use condition at all times.

9.2.2 Employees who handle acetic acid should be provided with the following equipment:

a) Protective clothing, aprons, shoes, gloves and hats, made of rubber or an equivalent impermeable material, synthetic resins which may be soluble in acetic acid shall not be used;

b) Chemical safety goggles for protection against splashes or irritating concentrations of vapour; and

c) Respirators, if the vapour concentrations are sufficiently high.

9.3 Safety Showers and Eye Baths

9.3.1 Safety showers shall be provided in readily accessible areas where acetic acid is being handled. These should be inspected and tested regularly and maintained in the working condition at all times.

9.3.2 A special eye washing fountain, a ready source of running tap water or a hose with gentle flow of drinking water shall be provided for eye irrigation. It should be frequently inspected and maintained in good working condition at all times.

10. FIRST AID

10.1 Contact with Skin — Whenever acetic acid comes in contact with skin, *the speed in removing it is of primary importance.* First aid shall be started immediately in cases of contact with acetic acid as delay in initiating treatment may result in injury.

10.1.1 Apply copious quantity of running water. This may best be accomplished while the man is under a safety shower. All contaminated clothing shall be removed immediately. No attempt should be made to neutralize the acetic acid with alkaline solution until all areas of contact have been thoroughly irrigated with running water.

10.1.2 In case of severe or extensive burns, shock symptoms, such as rapid pulse and sweating, may appear at any time. The patient should be kept in supine position and a physician should be called in.

10.1.3 No oil or ointment should be applied to the affected areas without specific directions from the physician.

10.2 Contact with Eyes — If even minute quantities of acetic acid enter the eyes, they should be immediately irrigated with copious quantity of running water for 15 minutes. The eyelids should be held apart during the irrigation to ensure contact of water with all the tissues of the surfaces of the eyes and lids. A physician, preferably an eye specialist, should be called in attendance at the first possible moment. After the first 15 minutes period of irrigation is completed, it is permissible as a first measure to instill two or three drops of 0·5 percent solution of pontocaine or an equally effective aqueous topical anesthetic. No oils or oily ointments should be instilled unless ordered by the physician.

10.3 Ingestion — Ingestion of concentrated acetic acid causes burns of the mucous membrane of the mouth, throat, oesophagus and stomach. Do not attempt to induce vomiting in patients who have swallowed strong solution of acetic acid. If the patient is conscious, encourage him to wash out his mouth with copious quantity of water, then have him drink milk, if available, mixed with the whites of eggs. If these are not immediately available, have him drink as much water as possible. A physician should be called in as soon as possible.

10.3.1 Do not give anything by mouth to an unconscious patient.

10.4 Inhalation — A worker who has been overcome by acetic acid vapours should be removed immediately from exposure to a fresh or uncontaminated atmosphere. If breathing is stopped, an effective means of artificial respiration should be initiated immediately. If oxygen inhalation apparatus is available oxygen should be administered, but only by a person authorized for such duty or by a physician. The patient should be kept comfortably warm, but not hot. A physician should be called in at once.

11. CLEANING AND REPAIRS OF TANKS

11.1 Periodic cleaning of equipment is necessary and frequency of cleaning will be determined by experience. Aluminium equipment requires cleaning due to accumulation of aluminium oxide sludge. Cleaning crew shall be thoroughly instructed in the job and its hazards.

11.2 Disconnect tank completely and, if possible, blank-off openings.

11.3 Tanks and equipment shall be thoroughly purged, before cleaning and repairs, by steaming and washing with water. Before workmen enter the tank, a competent person shall check the effectiveness of the purging and any possible oxygen deficiency.

11.4 Protective equipment shall be provided as necessary (*see* **9.2.2**).

11.5 A safety belt and life line for a man entering the storage tank shall be provided. A man on the outside of the tank shall keep the men in the tank under constant observation and at least two other men shall be available to help those in the tank in case of trouble.

12. WASTE DISPOSAL

12.1 Waste acetic acid may be flushed away with water with due regard to local, state and central laws regulating the health and pollution. As a safeguard against corrosion of sewer lines, the waste acid should first be neutralized with any readily available basic compounds, such as soda ash; acetate salts so formed are all water soluble and are easily flushed away.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	1 N = 1 kg.m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2

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